NASA Advances in Ultra-High Sensitivity, Incremental and Absolute Optical Encoders

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Lasers and Masers
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Optics
Spacecraft Design, Testing and Performance
Structural Mechanics

Avionics and Aircraft Instrumentation

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology.

19880059804
A two degree of freedom gyroscope with frictionless inner and outer gimbal pick-offs
Swain, R. E. J., British Aerospace, UK; Jan 1, 1987; 8p; In English; International Conference on the Mechanical Technology of Inertial Devices, Apr. 7-9, 1987, Newcastle-upon-Tyne; See also A88-47029; Copyright; Avail: Issuing Activity

   A two degree of freedom gyroscope for rapid start, short operating time, applications is described. Design features include thermoplastic gimbals with in situ moulded bearings, stored energy power sources in the form of either a spring or high pressure cold gas, obtained from a superplastic formed titanium pressure vessel, and noncontacting pick-offs. Inner gimbal angle is derived from a mark to space signal which is modulated linearly by areas of differing reflectivity on the surface of a spherical rotor. The outer gimbal pick-off is an absolute encoder which obtains multitrack accuracy from a single track by using a scale coded with a psuedorandom binary sequence.
AIAA

Automatic Pilots; Degrees of Freedom; Gimbals; Gyroscopes; Pressure Vessels; Superplasticity

TOP

Aircraft Stability and Control

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots.

19840026375 Dynamic Controls, Inc., Dayton, OH, USA
A digital linear position sensor for flight control actuation Final Report, Jun. 1982 – Sep. 1983
Jenney, G. D., Dynamic Controls, Inc., USA; Schreadley, H. W., Dynamic Controls, Inc., USA; May 1, 1984; 64p; In English
Contract(s)/Grant(s): F33615-82-C-3605
Report No.(s): AD-A144283; AFWAL-TR-84-3043; Avail: CASI; A04, Hardcopy; A01, Microfiche
    This report describes the digital position sensor using incremental encoding of a rod by using alternate washers of ferreous and nonferreous material. Sensors are mounted radially around the rod. The technique was successful. The report describes the theory, demonstration hardware and the test results.
CASI
Digital Transducers; Flight Control; Position (Location)

TOP

Spacecraft Design, Testing and Performance

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics.

19930007472 Rensselaer Polytechnic Inst., Dept. of Electrical, Computer, and Systems Engineering., Troy, NY, USA
Calibration of the Aronson 6-DOF robotic platform
Lin, Amy Y., Rensselaer Polytechnic Inst., USA; Aug 1, 1991; 62p; In English
Contract(s)/Grant(s): NAGW-1333
Report No.(s): NASA-CR-191856; NAS 1.26:191856; RPI-CIRSSE-102; Avail: CASI; A04, Hardcopy; A01, Microfiche
    A discussion is presented of the calibration of the Aronson six-degree-of-freedom platform. Absolute encoders are used to determine the starting positions of all six joints. The hardware implemented are described in detail. Software programs are used to calibrate the hardware and to build the look-up tables that are needed in determining the initial joint positions. The descriptions of all software routines used are given.
Author
Calibrating; Computer Programs; Degrees of Freedom; Joints (Junctions); Positioning; Robotics

TOP

19940021174 Arizona Univ., Dept. of Aerospace and Mechanical Engineering., Tucson, AZ, USA

Autonomous space processor for orbital debris advanced design project in support of solar system exploration

Ramohalli, Kumar, Arizona Univ., USA; Mitchell, Dominique, Arizona Univ., USA; Taft, Brett, Arizona Univ., USA; Chinnock, Paul, Arizona Univ., USA; Kutz, Bjoern, Arizona Univ., USA; USRA, Proceedings of the 8th Annual Summer Conference: NASA(USRA Advanced Design Program; Jan 1, 1992, pp. p 6-17; In English; See also N94-25665 07-80; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper is regarding a project in the Advanced Design Program at the University of Arizona. The project is named the Autonomous Space Processor for Orbital Debris (ASPOD) and is a NASA/Universities Space Research Association (USRA) sponsored design project. The development of ASPOD and the students' abilities in designing and building a prototype spacecraft are the ultimate goals of this project. This year's focus entailed the development of a secondary robotic arm and end-effector to work in tandem with an existent arm in the removal of orbital debris. The new arm features the introduction of composite materials and a linear drive system, thus producing a light-weight and more accurate prototype. The main characteristic of the end-effector design is that it incorporates all of the motors and gearing internally, thus not subjecting them to the harsh space environment. Furthermore, the arm and the end-effector are automated by a control system with positional feedback. This system is composed of magnetic and optical encoders connected to a 486 PC via two servo-motor controller cards. Programming a series of basic routines and sub-routines has allowed the ASPOD prototype to become more autonomous. The new system is expected to perform specified tasks with a positional accuracy of 0.5 cm.
Author

Automatic Control; **Autonomy**; **Controllers**; **End Effectors**; **Robot Arms**; **Space Debris**

Engineering (General)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention.

19980003803 NERAC, Inc., Tolland, CT USA

Shaft Angle Position and Velocity Encoders: Latest citations from the INSPEC Database

Aug. 1996; In English; Page Count Unavailable

Report No.(s): PB96-858501; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The bibliography contains citations concerning the theory and construction of shaft angle position and velocity encoders. Electrooptical and electromagnetic encoders are described. Absolute and incremental encoder types are included. Applications such as multi-axis machine control, robotics, and positional and velocity control systems are mentioned. The effects of eccentricity and ellipticity, line width and spacing non-uniformities, shaft wobble, coupling misalignments, and zero crossing and quantizing errors are described. Methods to minimize the effects of these errors are included. (Contains 50-250 citations and includes a subject term index and title list.)
NTIS

Bibliographies; **Coders**; **Coding**

19980214533

Space vehicle mechanisms: Elements of successful design

1998; In English; ISBN 0-471-12141-X; Copyright; Avail: Aeroplus Dispatch

This volume brings together accumulated industry experience in the design, analysis, and application of the mechanical systems used during space flight. The topics addressed include: stainless steel, beryllium and other widely used materials; bearings; lubricants and component lubrication; release devices; motors; optical encoders; resolvers; signal and power transfer devices; deployment devices; thermal design; radiation and survivability; electrical interfaces; and reliability.

AIAA

Conferences; Spacecraft Construction Materials; Spacecraft Design

Communications And Radar

Includes radar; radio, wire, and optical communications; land and global communications; communications theory.

19820006313 Telespazio S.p.A., Rome, Italy

Results and conclusions of the 120 and 180 Mbit/sec digital transmission tests

Vernucci, A., Telespazio S.p.A., Italy; ESA OTS: 3rd Year in Orbit; Aug 1, 1981, pp. p 69-73; In English; See also N82-14173 05-12; Sponsored by Interim Eutelsat; Avail: CASI; A01, Hardcopy; A03, Microfiche

Single channel and cochannel interference tests were performed on the OTS transponders at 120 and 180 Mbits/sec in order to test their suitability for inclusion in the European Communications Satellite (ECS). Ground stations were used to check breadboard model predictions of systems performance. Although at 120, band-edge effects were not considered, and at 180, transponder amplitude was absent, results predict degradation at high data rates for ECS. Additional degradation is expected due to multipath and adjacent channel interference. More data is required, especially since a demodulator, which comes within specifications in the back to back mode, may have problems in the real environment. Other aspects, e.g. absolute encoding, burst to burst power variation, and the 40% cosine roll of filters, also require further investigation.

CASI

Channel Capacity; Ots (ESA); Pulse Communication; Satellite Transmission; Transmission Efficiency

Electronics And Electrical Engineering

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry.

19820011609 National Centre of Tribology, European Space Tribology Lab., Risley, UK

British Aerodynamics Group (BAE) solar-array drive mechanism: Life test, stripdown and optical encoder examination

Walton, A. J., National Centre of Tribology, UK; Gillies, J., National Centre of Tribology, UK; Duvall, J. A., National Centre of Tribology, UK; Dec 1, 1980; ISSN 0250-4448; 31p; In English
Report No.(s): ESA-TRIB-2; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

    A drive mechanism which rotates a satellite solar array at 1 rev/day was tested. The real time life test simulated actual satellite operating conditions of vacuum and temperature (including eclipses) and lasted four years. Termination was caused by a failure in the optical sensing elements of the position sensing digital encoder. The mechanism behaves according to specification as regards drive motor power, error angle compared with a 24 hr clock and performance of power slip rings. Examination at the end of the test shows the mechanism to be in excellent mechanical condition, there being no features (apart from the encoder) that might limit the life to less than the projected seven years. Results for the main parameters are summarized. Details of the post test examination, which includes the measurements made on the optical encoder elements, are given.
CASI

Coders; **Mechanical Drives**; **Service Life**; **Solar Arrays**; **Space Environment Simulation**; **Thermal Vacuums**

TOP

19940024869 NASA Marshall Space Flight Center, Huntsville, AL, USA

Multi-speed multi-phase resolver converter

Alhorn, Dean, inventor, NASA Marshall Space Flight Center, USA; Howard, David, inventor, NASA Marshall Space Flight Center, USA; Feb 22, 1994; 23p; In English
Patent Info.: NASA-CASE-MFS-28855-1; US-PATENT-APPL-SN-199924
Report No.(s): NAS 1.71:MFS-28855-1; Avail: CASI; A03, Hardcopy; A01, Microfiche

    A multiphase converter circuit generates a plurality of sinusoidal outputs of displaced phase and given speed value from the output of an angular resolver system attachable to a motor excited by these multi-phase outputs, the resolver system having a lower speed value than that of the motor. The angular resolver system provides in parallel format sequential digital numbers indicative of the amount of rotation of the shaft of an angular position sensor associated with the angular resolver system. These numbers are used to excite simultaneously identical addresses of a plurality of addressable memory systems, each memory system having stored therein at sequential addresses sequential values of a sinusoidal wavetrain of a given number of sinusoids. The stored wavetrain values represent sinusoids displaced from each other in phase according to the number of output phases desired. A digital-to-analog converter associated with each memory system converts each accessed word to a corresponding analog value to generate attendant to rotation of the angular resolver a sinusoidal wave of proper phase at each of the plurality of outputs. By properly orienting the angular resolver system with respect to the rotor of the motor, essentially ripple-free torque is supplied to the rotor. The angular resolver system may employ an analog resolver feeding an integrated circuit resolver-to-digital converter to produce the requisite digital values serving as addresses. Alternative versions employing incremental or absolute encoders are also described.
NASA

Coders; **Digital to Analog Converters**; **Integrated Circuits**; **Memory (Computers)**; **Resolvers**; **Shafts (Machine Elements)**; **Sine Waves**

TOP

19960054784

Consideration for a high resolution of magnetic rotary encoder

Kikuchi, Y., Shinshu Univ, Japan; Nakamura, F.; Wakiwaka, H.; Yamada, H.; Yamamoto, Y.;
IEEE Transactions on Magnetics; September 1996; ISSN 0018-9464; 32, 5, pt. 2, pp. 4959-4961;
In English; Copyright; Avail: Issuing Activity

The structure of a magnetic rotary encoder is very simple compared with an optical type and is not affected in dust and mist conditions. However, a magnetic rotary encoder with an upper limit of encoder resolution of 2000 pulses per revolution(ppr) per track has lower resolution compared with an optical encoder. In this paper, a high resolution magnetic rotary encoder with 4000 ppr per track resolution utilizing a minimum number of magneto-resistive elements has been developed by using a double interpolation method. A parameter analysis of the magnetization and the detection processes for the main magneto-resistive output voltage using a finite element method is described.

Author (EI)

Finite Element Method; Interpolation; Magnetic Drums; Magnetization; Magnetoresistivity; Signal Distortion; Signal Encoding; Sine Waves

20000010428 Technical Univ. of Budapest, Hungary

Periodica Polytechnica Electrical Engineering

Wettl, F.; Tarjan-Fabry, M.; 1998; ISSN 0324-6000; Volume 42, No. 3, pp. 263-274; In English
Report No.(s): PB2000-100597; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

Contents include the following: Development of an X-band Scatterometer; Simulative analysis of Routing and Link Allocation Strategies in ATM Networks; Computer Aided Analysis of Medical, Ultra-sound-Echocardiographic Images; new Algorithm for Behavioral Test Generation; and Up-to-date Technique for Easy High-accuracy Position Acquisition with Sinusoidal Incremental Encoders.

NTIS

Electrical Engineering; Computer Techniques; Superhigh Frequencies

Fluid Mechanics and Thermodynamics

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling.

19820017606 Air Force Inst. of Tech., School of Engineering., Wright-Patterson AFB, OH, USA

Design, fabrication and testing of an axisymmetric, annular, subsonic diffuser and associated instrumentation systems Topical

Kelley, J. V., Jr., Air Force Inst. of Tech., USA; Dec 1, 1981; 94p; In English
Contract(s)/Grant(s): AF PROJ. 3066
Report No.(s): AD-A111162; AFIT/GAE/AA/81D-16; Avail: CASI; A05, Hardcopy; A01, Microfiche

Aerodynamic parametric data of annular diffuser flow field for gas turbine engines are not available in sufficient detail. They are badly needed for future high efficiency engine design. A subsonic, axisymmetric, annular diffuser model was designed for the purpose of making such highly detailed information available. The objective of the design was to approximate an actual gas turbine engine diffuser. The diffuser was built according to these design specifications. The instrumentation required to gather the necessary pressure, velocity, and turbulence parameters consisted of three pitot tube systems, a hot wire anemometer system and a laser doppler velocimeter (LDV) system using frequency counting. These three instrumentation systems were integrated into the diffuser to obtain data at each of three points along the longitudinal axis. At each point there were five stations along the annulus that were instrumented. A longitudinal traversing structure utilizing motorized traversers for

radial positioning and the capability to integrate absolute encoders was used to access the flow area.
DTIC
Annular Flow; Engine Parts; Flow Distribution; Gaseous Diffusion; Subsonic Flow

Instrumentation and Photography

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography.

19730019771 Officine Galileo S.p.A., Florence, Italy
Design study of an infrared sensor based on non-thermovoltaic detectors for accurate earth pointing of a geostationary satellite Final Report
Baldassini Fontana, R., Officine Galileo S.p.A., Italy; Ballerini, L., Officine Galileo S.p.A., Italy; Devidi, G., Officine Galileo S.p.A., Italy; Pieri, S., Officine Galileo S.p.A., Italy; Varano, I., Officine Galileo S.p.A., Italy; Jan 1, 1973; 263p; In English
Contract(s)/Grant(s): ESTEC-1400/71
Report No.(s): ESRO-CR-161; Avail: CASI; A12, Hardcopy; A03, Microfiche
    A design study was conducted to develop an infrared earth-horizon sensor capable of providing information on pitch-and roll-axis positions with respect to the local vertical, with an accuracy at null of 0.05 deg (3 sigma) from a nominally circular, geosynchronous orbit. The investigation was restricted to sensors employing pyroelectric and thermistor bolometer detectors. The first part of the study analyzes and compares various sensor concepts, such as static horizon sensors, edge trackers, and scanners. The second part consists of a detailed study of the preferred concept, which is a sensor operating on the signals coming from four thermistor bolometers whose fields of view are scanned through the earth-disc boundary by an oscillating mirror. The mirror scan amplitude is measured via an optical incremental encoder. The optimisation of the optical, mechanical and processing electronic parameters is reported and discussed. The error budget shows that the proposed sensor will meet the accuracy requirement.
CASI
Horizon Scanners; Infrared Scanners; Pointing Control Systems; Synchronous Satellites; Thermistors

19730053277
A precision control system for a large astronomical telescope.
Carleton, N. P.; Fay, S.; Grim, W. M., Jr.; Hoffman, T. E., Smithsonian Astrophysical Observatory, USA; Jan 1, 1973; 2p; In English; 14th; Joint Automatic Control Conference, June 20-22, 1973, Columbus, OH; See also A73-38028 19-10; Copyright; Avail: Issuing Activity
    The drive systems for a multiple mirror telescope described will use a mini-computer to control in real time the operation of the telescope. The computer will automatically point the telescope toward a celestial object defined by its sidereal coordinates, allowing for the refraction of the atmosphere, deflection in the telescope structure, and other mathematically definable and repeatable perturbations. The latter may be caused by a nonvertical azimuth axis, bearing wobble, or nonorthogonal altitude and azimuth axes. Tracking of the object is then achieved by calculating, in real time, incremental position commands for each rotation axis. The outputs of incremental and absolute encoders on each axis are compared to computed values to provide error signals for closed loop control.
AIAA
Minicomputers; Optical Tracking; Pointing Control Systems; Real Time Operation; Telescopes

19750008745 Mound Lab., Miamisburg, OH, USA

Automated theta-theta diffractometer and sample containment system for the investigation of liquids and solids at high temperatures

Hudgens, C. R., Mound Lab., USA; Jan 1, 1974; 14p; In English; Am. Crystallographic Assoc., 19 Aug. 1974, Univ. Park, PA, USA

Contract(s)/Grant(s): AT(33-1)-GEN-53

Report No.(s): MLM-2173(OP); CONF-740838-1; Avail: CASI; A03, Hardcopy; A01, Microfiche

A theta-theta diffractometer (Picker) was modified for computer control by the installation of a stepping motor and an absolute encoder on the two-theta drive shaft. The detection system consists of a balanced filter, scintillation counter, and conventional PHA electronics inputting into computer-compatible high-speed scalers. The sample support is a hollow, refractory metal post, heated from within by an electron beam concentrated under the sample. The sample is protected by a controllable-composition, low-pressure atmosphere in a chamber completely isolated from that of the electron beam heater. For studies on highly active metals, atmospheres of helium or argon are used. A specially designed mercury vapor pump, conventionally trapped, is used as a positive pressure pump for recirculation of the gas. Reducing conditions may be provided by controlled addition of hydrogen to the atmosphere through a palladium diffuser. The system was designed for the determination of the liquid structures of the transuranium elements.

CASI

Diffractometers; Electric Motors; High Temperature Research; Scintillation Counters

19760050448 American Science and Engineering, Inc., Cambridge, MA, USA

Hadamard transform imager and imaging spectrometer

Swift, R. D., American Science and Engineering, Inc., USA; Wattson, R. B., American Science and Engineering, Inc., USA; Paganetti, R., American Science and Engineering, Inc., USA; Decker, J. A., Jr., Spectral Imaging, USA; Harwit, M., Cornell University, USA; Jun 1, 1976; 15p; In English

Contract(s)/Grant(s): NAS1-12690; Copyright; Avail: Issuing Activity

An imager and a spectrometric imager, which achieve multiplexing by the use of binary optical encoding masks, have been built and tested. The masks are based on orthogonal, pseudorandom digital codes derived from Hadamard matrices. The spatial (and/or spectral) data are therefore obtained in the form of a Hadamard transform of the spatial (and/or spectral) scene. Computer algorithms are used to decode the data and reconstruct images of the original scene. The hardware, algorithms processing and display facility are described. A number of spatial and spatial/spectral images, obtained in the laboratory, are presented.

AIAA

Imaging Techniques; Signal Encoding; Signal Processing; Spatial Filtering; Spectrometers; Transformations (Mathematics)

19770026536 Weapons Research Establishment, Adelaide, Australia
An accurate angular position and angular velocity instrument based on an optical incremental encoder
Humski, B., Weapons Research Establishment, Australia; Dec 1, 1976; 35p; In English
Report No.(s): WRE-TN-1730(WR/D); Avail: CASI; A03, Hardcopy; A01, Microfiche

An instrument designed to measure the instantaneous angular position and angular velocity of a freely rotating wind tunnel model is described. The transducer, based on a photo-optical incremental encoder, is insensitive to vibrations. Although primarily intended for studying the roll behaviour of a wind tunnel model, its high resolution, instantaneous response to roll reversal, freedom from accummulated errors and error detection capabilities make it suitable for general purpose usage in a wide range of applications.
CASI
Angular Velocity; Data Acquisition; Measuring Instruments; Transducers

19780068027
Windvane with optical transducer
Patil, M. S.; Kutty, I. A., Bhabha Atomic Research Centre, India; Journal of Applied Meteorology; Aug 1, 1978; 17, pp. Aug. 197; In English; p. 1232, 1233; Copyright; Avail: Issuing Activity

An optical transducer is described which is designed for use with windvanes or in any other application where angular deflection needs monitoring. The system consists of a 6-bit optical encoder with a resolution of 5 deg 37 min and a decoder, employs a rotating binary pattern carried on two disks, is free of mechanical deterioration, and has the capability of providing a digitized output. The coding/decoding electronics is discussed along with a problem involving alignment accuracy that was overcome by using a seventh photoresistor plus a latch circuit for alignment control. It is noted that during field testing the output was converted into analog form with the aid of a ladder network and recorded on a strip-chart current recorder.
AIAA
Optical Measuring Instruments; Transducers; Wind Direction; Wind Vanes

19830042370
Precision optical encoder
Huang, C.-C.; Hodor, J.; Barney, J., Lockheed Missiles and Space Co., Inc., USA; Jan 1, 1981; 9p; In English; 25th; Control and communication technology in laser systems; Twenty-fifth Annual International Technical Symposium, San Diego, August 25-26, 1981, San Diego, CA; See also A83-23576 09-17; Copyright; Avail: Issuing Activity

A precision optical encoder with a potential accuracy of over 0.1 arcsec over 360 degrees has been developed. The encoder measures the rotation of a drum by sensing the sliding movement of the drum grating with respect to a laser-based displacement sensor. The fabrication of the drum grating is assessed, and the basic equation for the optical encoder is presented. Results of tests on the angular alignment sensor breadboard are provided. The encoder is compared to the coded disk in terms of range, resolution, peak accuracy and maximum slew rate.
AIAA
Displacement Measurement; Instrument Errors; Laser Applications; Optical Communication; Signaling

19840038251

Theodolite-Pilot balloon system with automatic detection of wind vertical profile
Teodolite per palloni Pilot con rilevamento automatico del profilo verticale del vento
Evangelisti, F.; Giovanelli, G., CNR, Italy; Rivista di Meteorologia Aeronautica; Sep 1, 1983; ISSN 0035-6328; 43, pp. 137-145; In Italian; In Italian; Avail: Issuing Activity

A modification on a standard theodolite Pilot balloon system has been carried out. It consists of two incremental encoders allowing the automatic detection of zenithal- and azimuthal-angle values in prefixed time intervals. Moreover, the microprocessor system connected to the angular transducers calculates the horizontal wind speed and its direction at different heights during the balloon flight. The device greatly simplifies theodolite measurements and assures better reliability of angle-data detection. The angular error has been found to be less than + or – 0.1 degree in laboratory and field measurements.
AIAA
Balloon-Borne Instruments; Coders; Electronic Control; Theodolites; Wind Measurement; Wind Profiles

19850007831 Army Combat Systems Test Activity (Provisional), Aberdeen Proving Ground, MD, USA
ILIR task of digital recoil travel measurement system Final Report, Oct. 1982 – Jul. 1984
Betzold, V. A., Army Combat Systems Test Activity (Provisional), USA; Francis, C. L., Army Combat Systems Test Activity (Provisional), USA; Jul 1, 1984; 61p; In English
Contract(s)/Grant(s): DA PROJ. 1L1-61101-A-91-A
Report No.(s): AD-A147102; USACSTA-6045; Avail: CASI; A04, Hardcopy; A01, Microfiche

A study was conducted to improve measurement of large caliber weapon recoil travel. Since the 1950s, a continuous rotation, single turn potentiometer driven by a rack and pinion gear has been used on a variety of weapons. Satisfactory data has been produced by this system, but the data records suffer from a number of problems caused by the potentiometer. Therefore, the potentiometer was replaced by a digital incremental optical shaft encoder. Circuitry was developed to interface the encoder output to a digital data acquisition system. Software was then written to process the data at the firing site, and provide a near real-time plot of recoil travel and velocity versus time. Originator supplied keywords include: Ballistic Test Site Terminal, and Incremental Optical Encoder.
DTIC
Ballistics; Coders; Digital Systems; Real Time Operation; Weapon Systems

19870047978

A hybrid incremental/absolute optical encoder for measuring the position of telescope domes
Kibrick, Robert; Delaney, Calvin R.; Osborne, Jack, Lick Observatory, USA; Jan 1, 1986; 9p; In English; See also A87-35201; Copyright; Avail: Issuing Activity

This report presents a design for an inexpensive and highly reliable dome position encoder which has few moving parts and which eliminates the need for a mechanical engagement to the dome. This hybrid incremental/absolute optical encoder is now in use on the dome of the 1-meter Nickel Telescope at Lick Observatory, and will soon be installed on the dome of the Observatory's Shane 3-meter Telescope. This report discusses the costs and important points of the construction, installation, operation, and maintenance of the encoder. It also explores the feasibility of using this encoder on the domes of large telescopes such as the Keck Observatory 10-meter.
AIAA
Coders; Domes (Structural Forms); Fault Tolerance; Optical Measuring Instruments; Position Sensing; Telescopes

19920049441

An integrated propeller vane anemometer

Michaelis, M. C., NCAR, USA; Jan 1, 1991; 6p; In English; 7th; Symposium on Meteorological Observations and Instrumentations, Jan. 14–18, 1991, New Orleans, LA, USA; See also A92-32051; Copyright; Avail: Issuing Activity

The latest step in the evolution toward the use of integrated sensor at the PAM II system of the NCAR Surface and Sounding System Facility has been the conversion of Gill propeller vane to an integrated unit. The hardware and software design, user programming, and performance characteristics of the vane are examined. The vane was modified by adding an optical encoder for wind direction detection and microprocessor electronics to allow fully calibrated data output. The original sensor housing was physically modified to add the optical encoder and electronics board. The sensor may be programmed to output U and V wind vectors as well as speed and direction information. Output data rates may be varied to suit user requirements.
AIAA

Anemometers; Meteorological Instruments; Onboard Data Processing; Propeller Fans; Wind Measurement

19980130883

The Incremental Motion Encoder – A sensor for the integrated condition monitoring of rolling element bearings in machine tools

Ayandokun, K., Nottingham, Trent Univ., UK; Orton, P. A., Nottingham, Trent Univ., UK; Sherkat, N., Nottingham, Trent Univ., UK; Thomas, P. D., Nottingham, Trent Univ., UK; Poliakoff, J. F., Nottingham, Trent Univ., UK; 1995, pp. 28–37; In English; Copyright; Avail: Aeroplus Dispatch

This paper presents research into the use of a novel rotary motion sensor for the condition monitoring of rolling element bearings. This sensor, the Incremental Motion Encoder (IME), is based upon a patented development of the optical encoder commonly used in machine tools for sensing angular position and rotational speed. The IME combines these measurements with that of shaft center position in two dimensions. This motion of the shaft center is directly related to the condition of the bearings supporting the shaft. to illustrate the IME principle, experimental results showing the ability of the sensor to distinguish between bearing defects and external sources of vibration are presented. Measurement of shaft loading with the sensor is also described. Currently, machine tool condition is most often measured by external sensors, such as accelerometers or acoustic emission transducers, which are not parts of the machine itself. The IME is ideally suited to being designed into a machine tool so as to integrate a condition monitoring facility into the computer control of the machine. The paper concludes by describing the current technology which will allow sensors based on the IME principle to be integrated directly into rolling element bearings for this purpose.
Author (AIAA)

Machine Tools; Roller Bearings; Sensors; Coders

19980214551

Feedback devices. II – Optical encoders

Malcolm, Tim, BEI Sensors and Motion Systems Co., USA; Space vehicle mechanisms: Elements of successful design; 1998, pp. 395-419; In English; Copyright; Avail: Aeroplus Dispatch

Design alternatives, input formats, outputs, error descriptions, error sources and solutions, mountings, code disk design and assembly, environmental effects, and testing of optical decoders for spacecraft applications are discussed. The use of optical encoders in the Hubble Space Telescope star selector servo subsystem and the Space Shuttle remote manipulator system is briefly considered along with precautions and research efforts in optical encoders.

AIAA

Coders

Lasers and Masers

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs.

19800039192

Mirror position display equipment for the target chamber mirror mounts of the LASL HELIOS laser fusion facility

Wells, F. D.; Remington, D. A., California, University, USA; Jan 1, 1979; 5p; In English; Engineering – Key to the future, April 25-27, 1979, Sacramento, CA; See also A80-23359 08-31; Copyright; Avail: Issuing Activity

Equipment has been fabricated which records the absolute positions of sixteen mirror mounts used to direct and focus eight high-energy laser beams for research in laser induced fusion. Each mirror mount is driven by three stepping motors, controlled to produce the motions of Focus, Tilt, and Rotate relative to the target. Stepping of the motors is sensed by incremental optical encoders coupled to the motor drive shafts. Outputs from the encoder tracks are multiplexed to a microprocessor which transmits motor step information via a fiber optical data link to a Mirror Position Display chassis. This unit accumulates the steps, stores the motor positions, displays mirror position data to the operator, and provides the equipment control functions. Standby battery power is included to retain the motor step data in the event of power failure.

AIAA

High Power Lasers; Laser Fusion; Laser Targets; Magnetic Mirrors; Numerical Control

Mechanical Engineering

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated.

19880047262
Tracking a 150 ton altitude-azimuth telescope to sub-arcsecond accuracy
Barlow, David J.; Blanco, Daniel R.; Poyner, Anthony D., Multiple Mirror Telescope Observatory, USA; Jan 1, 1987; 8p; In English; Structural mechanics of optical systems II, Jan. 13-15, 1987, Los Angeles, CA, USA; Sponsored by SPIE; See also A88-34486
Contract(s)/Grant(s): NSF AST-79-25421; Copyright; Avail: Issuing Activity

The Multiple Mirror Telescope is a 150 ton optical instrument composed of an array of six 1.8 m diameter folded Cassegrain telescopes. A mount for the array uses conventional ball bearings and gear trains to permit the telescope to track in two axes, azimuth and altitude. A computer-controlled servo system uses a 26-bit absolute encoder and associated electronics to achieve an all-sky pointing accuracy approaching 1.0 arcsecond RMS, and a tracking accuracy approaching 0.1 arcsecond RMS.
AIAA
Ball Bearings; Cassegrain Optics; Optical Equipment; Reflecting Telescopes; Tracking (Position)

19900017015 Maryland Univ., College Park, MD, USA
University of Maryland walking robot: A design project for undergraduate students
Olsen, Bob, Maryland Univ., USA; Bielec, Jim, Maryland Univ., USA; Hartsig, Dave, Maryland Univ., USA; Oliva, Mani, Maryland Univ., USA; Grotheer, Phil, Maryland Univ., USA; Hekmat, Morad, Maryland Univ., USA; Russell, David, Maryland Univ., USA; Tavakoli, Hossein, Maryland Univ., USA; Young, Gary, Maryland Univ., USA; Nave, Tom, Maryland Univ., USA; Jan 1, 1990; 130p; In English
Contract(s)/Grant(s): NGT-21-002-800
Report No.(s): NASA-CR-186839; NAS 1.26:186839; Avail: CASI; A07, Hardcopy; A02, Microfiche

The design and construction required that the walking robot machine be capable of completing a number of tasks including walking in a straight line, turning to change direction, and maneuvering over an obstacle such as a set of stairs. The machine consists of two sets of four telescoping legs that alternately support the entire structure. A gear-box and crank-arm assembly is connected to the leg sets to provide the power required for the translational motion of the machine. by retracting all eight legs, the robot comes to rest on a central Bigfoot support. Turning is accomplished by rotating the machine about this support. The machine can be controlled by using either a user operated remote tether or the on-board computer for the execution of control commands. Absolute encoders are attached to all motors (leg, main drive, and Bigfoot) to provide the control computer with information regarding the status of the motors (up-down motion, forward or reverse rotation). Long and short range infrared sensors provide the computer with feedback information regarding the machine's relative position to a series of stripes and reflectors. These infrared sensors simulate how the robot might sense and gain information about the environment of Mars.
CASI
Mars Surface; Robots; Roving Vehicles; Walking Machines

19910008827 Maryland Univ., Dept. of Mechanical Engineering., College Park, MD, USA

Walking robot: A design project for undergraduate students

USRA, Proceedings of the 6th Annual Summer Conference: NASA(USRA University Advanced Design Program; Nov 1, 1990, pp. p 117-122; In English; See also N91-18121 10-12; Avail: CASI; A02, Hardcopy; A03, Microfiche

The design and construction of the University of Maryland walking machine was completed during the 1989 to 1990 academic year. It was required that the machine be capable of completing a number of tasks including walking a straight line, turning to change direction, and manuevering over an obstacle such as a set of stairs. The machine consists of two sets of four telescoping legs that alternately support the entire structure. A gear box and crank arm assembly is connected to the leg sets to provide the power required for the translational motion of the machine. by retracting all eight legs, the robot comes to rest on a central Bigfoot support. Turning is accomplished by rotating this machine about this support. The machine can be controlled by using either a user-operated remote tether or the onboard computer for the execution of control commands. Absolute encoders are attached to all motors to provide the control computer with information regarding the status of the motors. Long and short range infrared sensors provide the computer with feedback information regarding the machine's position relative to a series of stripes and reflectors. These infrared sensors simulate how the robot might sense and gain information about the environment of Mars.

CASI

Feedback; Infrared Detectors; Robots; Walking Machines

19930021123 Canadian Space Agency, Ottawa Ontario, Canada

Robot arm with positional absolute encoded joints

Yeung, S. K., Canadian Space Agency, Canada; Baribeau, C., Ottawa Univ., Canada; Pharand, A., Ottawa Univ., Canada; Petriu, E., Ottawa Univ., Canada; Engineering Inst. of Canada, Canadian Conference on Electrical and Computer Engineering, Volumes 1 and 2; Jan 1, 1990, pp. 4 p; In English; See also N93-30215 11-31; Avail: Engineering Inst. of Canada, 2050 rue Mansfield, Suite 700, Montreal, Quebec H3A 1Z2 Canada, Unavail. Microfiche

An absolute position measurement method used for control of an experimental three-joint robot arm is based on pseudo random binary sequence properties. A scanning technique is used to solve the code reading ambiguity problems. An 8-bit absolute position encoder was implemented in each robot joint and tested. The absolute encoder is used in conjunction with a conventional incremental encoder mounted on the input motor shaft. This solution provides the advantages of both position measuring techniques, the absolute encoder's noise immunity, and the incremental encoder's very high resolution. The control algorithm and hardware implementation are discussed.

Author (CISTI)

Coders; End Effectors; Position Indicators; Pseudorandom Sequences; Robot Arms

19990036925
The 1.8 meter Spacewatch Telescope Motion Control System
Perry, M., Arizona, Univ., Tucson, USA; Bressi, T., Arizona, Univ., Tucson; McMillan, R., Arizona, Univ., Tucson; Tubbiolo, A., Arizona, Univ., Tucson; Barr, L., Barr Engineering Arts, USA; 1998, pp. 450-465; In English; Copyright; Avail: AIAA Dispatch

The 1.8-m Spacewatch telescope and its building on Kitt Peak were dedicated on June 7, 1997 for the purpose of finding previously unknown asteroids and comets. The primary mirror and cell around which the telescope are designed are from the Multi-Mirror Telescope (MMT) on Mt. Hopkins in Arizona. The telescope's friction drive system allows backlash-free control of its altitude-over-azimuth mount. The mount features bearings of small radii and plenty of motor torque to compensate for wind buffeting. Both incremental and absolute encoders will be used; the absolute encoders will update the position derived from incremental encoders to compensate for the microslipping that is an unavoidable consequence of a friction drive. The control system features commercially produced servo controller cards that are programmed from a user interface program running in a PC under DOS. Realtime operation of the drive is controlled by the interface cards, leaving the PC free to run the display of the position readout and accept keyboard input from the observer without interfering with the drive. It is argued that this design offers the greatest flexibility and accuracy for our search programs.
Author (AIAA)
Telescopes; Supports; Electric Motors; Servocontrol

Structural Mechanics

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure.

19950026218 Technische Univ., Applied Mathematics Section., Delft, Netherlands
Realisation of a realtime position determination mechanism
Lemmens, Kees, Technische Univ., Netherlands; Jan 1, 1994; ISSN 0922-5641; 50p; In English
Report No.(s): REPT-94-82; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A realtime position determination for an aeroelastic oscillator to study wind induced oscillations (galloping) in overhead transmission lines is described. The setup consists of a pendulum with a profile attached on one side and counterweights at the other side to keep the setup balanced. The profile is positioned in a windtunnel and the complete system starts oscillating as a result of the external lift and drag forces induced by the airflow on this profile. to obtain useful results from the windtunnel experiments it is crucial to have a reliable and accurate device to register the exact position of the oscillator many times per second. A digital device based on the incremental encoders as used in many industrial setups was developed. The incremental encoders have a number of grooves on their circumference and two optocouplers that produce two 90 deg shifted square wave pulse trains when the system rotates. The pulse trains are processed with a specially designed electronic interface. Reading the output produced by this chip requires many control signals that are normally provided through hardware. However, these signals are provided through dedicated software, as this gives the opportunity to change the specifications in a very easy way.
ESA
Aeroelasticity; Air Flow; Computer Programs; Cross Flow; Oscillations; Pendulums; Position Sensing; Real Time Operation; Transmission Lines; Wind Tunnel Tests

Computer Programming And Software

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20000048266 Naval Academy, Annapolis, MD USA
Distributed Processing Using Single-chip Microcomputers
Pritchett, William C.; Jan. 1996; 88p; In English
Report No.(s): AD-A375765; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
    This project investigates the use of single-chip microprocessors as nodes in a token ring control network and explores the implementation of a protocol to manage communication across such a network. A control network is useful when the event to be controlled is located at some distance from the inputs required to control it; likewise, a control network is useful when an application receives inputs from more sources than a single microprocessor is capable of handling. Such a network allows nodes to share only the information that is essential for each to perform, eliminating the need for a powerful and costly computer. This makes it extremely effective in a wide variety of applications ranging from missiles to home security systems to smart automobiles. One type of control network is the token ring network, where each node is connected serially with the node immediately following tt and the one preceding it. Its efficiency, simplicity, and determinacy make it an excellent choice in a small control network. A specific scenario is examined where the position of a marble along a motor driven track is controlled using inputs from a user operating a PC as well as a microcomputer-driven interface module, an optical encoder mounted on the motor, and a camera located above the track. Using the information of the state variables as well as preferences of the user, a digital control system is developed to move the marble to the proper position.
DTIC
Research; Microcomputers; Distributed Processing; Microprocessors

Cybernetics, Artificial Intelligence and Robotics

Includes feedback and control theory, information theory, machine learning, and expert systems.

19840009865 Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, USA
Robotic technology applied to Army mobility systems
Chavez, R. J., Army Mobility Equipment Research and Development Command, USA; Amazeen, C. A., Army Mobility Equipment Research and Development Command, USA; Keller, H. L., Army Mobility Equipment Research and Development Command, USA; Jul 1, 1983; 56p; In English
Contract(s)/Grant(s): DA PROJ. 1L1-62733-AH-20
Report No.(s): AD-A134728; AD-E301230; MERADCOM-2387; Avail: CASI; A04, Hardcopy; A01, Microfiche
    Recognizing that the U.S. Army Corps of Engineers has a need for applying industrial robotic technology to high-risk and labor intensive tasks performed in the environment of a modern battlefield, USAMERADCOM started a small investigative project in a specific robotic application area--robotics applied to rapid excavation. The excavator used was a modified J. I. Case Model 35 Backhoe mounted on a highly mobile Mercedes Unimog truck. The conditions of the modern battlefield make rapid excavation extremely hazardous to the human operators

due to the advent of highly accurate, technologically sophisticated weapons systems and the possibility of nuclear, biological, and/or chemical contamination of the battlefield environment. The goal, then, of the project was to eliminate or reduce through automation as much of the manual digging operation of the backhoe as would be consistent with current operating procedures. This report describes the system design and modifications associated with the implementation of a hierarchical 8-bit microprocessor control structure to the backhoe excavation cycle. The feedback control structure associated with driving a third order system consisting of electro-hydraulic values, microprocessors, optical encoders, and inertial loads is described along with an analysis of the predicted transient response.
DTIC
Combat; **Excavation**; **Feedback Control**; **Robotics**

19850043099
High resolution position and velocity measurement with incremental encoders
Beckmann, U., Max-Planck-Institut fuer Radioastronomie, Germany; Bardenheuer, R., Institut de Radio Astronomie Millimetrique, Spain; Jan 1, 1984; 5p; In English; Advanced technology optical telescopes II, September 5, 6, 1983, London; See also A85-25230 10-89; Copyright; Avail: Issuing Activity

The use of incremental encoders to measure velocity and position resolution for telescope servo-control systems is discussed. The electronics and computational requirements of a typical encoder system are described, and a schematic diagram is provided to illustrate the connection between the servo motors and position measurement computer of a 30-meter millimeter-wave radio telescope. It is shown that incremental encoding of position measurements can reduce position error to below a few arcsecs for telescopes with an antenna beamwidth of less than 1 arc min.
AIAA
Coders; **Radio Telescopes**; **Signal Encoding**; **Tracking (Position)**; **Velocity Measurement**

19990072262
New chapter in encoder-based motion control
Monnin, Andrew, Stegmann Inc., USA; Sensors (Peterborough, NH); Nov, 1998; ISSN 0746-9462; Volume 15, no. 11; 6p; In English; Copyright; Avail: Issuing Activity

Dramatic changes in the motion control market, together with innovations in the design and manufacture of absolute encoders, are opening the door to greater use of absolute feedback systems. The digital drive, several new encoder technologies, and higher performance interfaces have paved the way for motor feedback systems that combine the advantages of incremental and absolute encoders with smart sensor capabilities. These systems are described along with recent developments in magnetic encoder technology, fieldbus encoders, programmable smart encoders, and hollow-shaft encoders.
EI
Shafts (Machine Elements); **Feedback Control**; **Positioning**; **Optical Measuring Instruments**

19990094867
Velocity estimation for robot manipulators using neural network

Chan, S. P., Nanyang Technological Univ., Singapore; Journal of Intelligent and Robotic Systems: Theory & Applications; Oct, 1998; ISSN 0921-0296; Volume 23, no. 2-4, pp. 147-163; In English; Copyright; Avail: Issuing Activity

In robot manipulators, optical incremental encoders are widely used as the transducers to monitor joint position and velocity information. With incremental encoder, positional information is determined as discrete data relative to a reference (home) position. However, velocity information can only be deduced by processing the position data. In this paper, a method of using a neural network to estimate the velocity information of robotic joint from discrete position versus time data is proposed and evaluated. The architecture of the neural net and the training methodology are presented and discussed. This approach is then applied to estimate the joint velocity of a SCARA robot while performing an electronic component assembly task. Based on computer simulations, comparison of the accuracy of the neural network estimator with two other well established velocity estimation algorithms are made. The neural net approach can maintain good performance even in the presence of measurement noises.
Author (EI)

Statistical Analysis; Manipulators; Neural Nets; Computer Vision; Trajectory Planning; Parameter Identification

Atomic and Molecular Physics

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra.

19910014568 Princeton Univ., Dept. of Chemistry., NJ, USA
Molecular dynamics simulator for optimal control of molecular motion Final Report, 20 Sep. 1989 - 19 Sep. 1990

Rabitz, Herschel, Princeton Univ., USA; Dec 12, 1990; 27p; In English
Contract(s)/Grant(s): DAAL03-89-K-0173
Report No.(s): AD-A232801; ARO-27577.1-CH; Avail: CASI; A03, Hardcopy; A01, Microfiche

In recognition of recent interest in developing optimal control techniques for manipulating molecular motion, this paper introduces a computer-driven electro-mechanical analog of this process. The resultant Molecular Dynamic Simulator (MDS) is centered around a linear air track for which the atoms of the controlled molecule are simulated as nearly frictionless carts on the track. Bonds in the simulated molecule are described by precision springs, and the interaction with an external optical field is simulated through a computer-based linear driver. When the MDS is operated in the harmonic regime, it can be used as an exact analog of molecular scale quantum systems through Ehrenfest's Theorem, or equivalently as a classical set of coupled oscillators. The tools of optimal control theory currently being applied at the molecular scale are used to design the forcing function for the MDS. Optical encoders are used to measure bond distances for graphic representation of the MDS behavior. Bond breaking can also be simulated by bond-length sensitive trigger-release mechanisms. The MDS is especially useful as a modelling tool to bridge theoretical studies and eventual laboratory experiments at the true molecular scale.
DTIC

Computer Techniques; Molecular Dynamics; Molecular Oscillators; Molecular Structure; Motion Simulation; Optimal Control; Quantum Theory; Simulators

Optics

Includes light phenomena and the theory of optical devices.

19780010969 Massachusetts Inst. of Tech., Cambridge, MA, USA
The mount performance of the second GEODSS telescope Project Report
Landon, S. N., Massachusetts Inst. of Tech., USA; Nov 3, 1977; 30p; In English
Contract(s)/Grant(s): F19628-78-C-0002; AF PROJ. 2128
Report No.(s): AD-A048745; ETS-20; ESD-TR-77-275; Avail: CASI; A03, Hardcopy; A01, Microfiche

    The second GEODSS telescope has an improved drive system consisting of a single DC drive motor on each axis. This arrangement should provide a stable and reliable drive system for the telescope, which is driven by incremental encoders. Measurements on the response of the telescope to computer commanded rates were therefore taken. These measurements were made via two computer programs; one sends rate commands to the telescope, and the other monitors the resulting positions of the telescope. The results of these measurements show that this telescope responds very accurately to rate commands over the range of most interest to us: + or - 400 arc seconds per second. Data is also presented on the performance of the telescope with the Real-Time System. Specifically, the step and settle time of the telescope over a 3.7 degree field is examined. That field corresponds to the overlapped full field on the 14 inch telescope. A very satisfactory step and settle time of approximately 2 seconds has been achieved by the telescope for that case.
CASI
Controllability; **Supports**; **Telescopes**

19850006373 Department of the Navy, Washington, DC, USA
Electrooptical matrix multiplication using the twos complement arithmetic for improved accuracy
Bocker, R. P., Department of the Navy, USA; Clayton, S. R., Department of the Navy, USA; Bromley, K., inventors, Department of the Navy, USA; May 21, 1984; 20p; In English
Patent Info.: US-PATENT-APPL-SN-612288
Report No.(s): AD-D011252; Avail: CASI; A03, Hardcopy; A01, Microfiche

    This invention is directed to providing an apparatus and method for improving accuracy in an electooptical matrix-matrix multiplier by using twos complement arithmetic. A source of pulsed collimated light illuminates a first matrix of optical encoded information of numbers in the twos complement binary representation and a second matrix of optical encoded information of numbers in the twos complement binary representation that mutually orthogonally are displaced with respect to one another in synchronization with the pulsing of the collimated light source. A photodetector array is located to add multiplied encoded information of numbers in the twos complement binary representation of the first matrix providing means and the second matrix providing means to be expressed as mixed binary representation signals. A suitable decoder is coupled to the photodetector array for decoding the mixed binary representation signals into twos complement binary representations or digital representations for use by interconnected processing devices. Staggering the encoded twos complement binary representations of one matrix of information and orthogonally advancing it with respect to the other matrix of information allows the addition of multiplied mixed binary representations by the photodetector array to provide accurate representations of decimal mathematical numbers.
DTIC
Arithmetic; **Coding**; **Electro-Optics**; **Matrices (Mathematics)**; **Multiplication**; **Optical Data Processing**; **Photometers**

19880039040

Optical-actuator-multiplexed, serial transmission fiber encoder

Johnson, Mark, York Hamburg Sensor GmbH; Hamburg, Technische Universitaet, USA; Optics Communications; Jan 15, 1988; ISSN 0030-4018; 65, pp. 87-90; In English; Copyright; Avail: Issuing Activity

An optically-driven, electromechanical actuator is described, which can sequentially connect a single multimode input fiber to each fiber of a 12-fiber array. The optical drive is effected remotely over a long fiber cable, and only 16 microW received optical power is required for resonant scanning of the array. The output array fibers are configured to read ten tracks of a reflective absolute encoder disk, and to transmit the digital word to a readout station. The inherent serial, digital code format conveys the readout with a high level of transmission-path independence.

AIAA

Actuators; **Data Transmission**; **Fiber Optics**; **Multiplexing**; **Signal Encoding**

19930048923

Optical encoders using pseudo random binary sequence scales

Johnston, J. S.; Romer, A. E.; Beales, M. S., Rosemount, Ltd., UK; In: Specialty fiber optic systems for mobile platforms; Proceedings of the Meeting, Boston, MA, Sept. 5, 1991 (A93-32915 12-74); 1991, pp. 126-132.; In English; See also A93-32915; Copyright; Avail: Issuing Activity

Instruments based on a track encoded with a pseudo-random-binary-sequence, a small section of which is imaged onto a line-scan sensor, are described. The digital word image gives the coarse position while the exact location of edges in the image gives the fine position. It is concluded that the use of a coarse scale with post processing of the image permits the design of robust rotary and linear encoders for a wide range of industrial and aircraft environments.

AIAA

Binary Codes; **Coders**; **Digital Data**; **Fiber Optics**; **Optical Scanners**; **Pseudorandom Sequences**

19940015583 Department of the Navy, Washington, DC, USA

Optical encoding of imaging data

Garcia, Joseph P., inventor, Department of the Navy, USA; Aug 3, 1993; 6p; In English
Patent Info.: Filed 16 Jul. 1990; US-PATENT-5,233,440; US-PATENT-APPL-SN-553058
Report No.(s): AD-D015915; Avail: US Patent and Trademark Office, Unavail. Microfiche

Optical imaging data sampled through a sensing array of spaced receiving end faces of optic fiber bundles, is encoded by the different signal delay lengths of the fibers forming the respective bundles. The geometry of such end faces in the array is such as to effect encoding in dependence on the angular orientation and position of sampled segments of the optical data relative to the end faces on which such sampled segments impinge.

DTIC

Coding; **Images**; **Imaging Techniques**; **Optical Data Processing**

19940019573 Codechamp S.A., Champagnat, France
Encoders for space applications
Gaumet, Daniel, Codechamp S.A., France; Grass, Alain, Codechamp S.A., France; Bongrand, L., Codechamp S.A., France; ESA, The Fifth European Space Mechanisms and Tribology Symposium; Apr 1, 1993, pp. 2 p; In English; See also N94-23985 06-37; Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Advanced optical encoders for space applications are presented. In the field of angular position control, optical encoders show significant advantages in high resolution, and low weight and consumption. The reliability of the technology was demonstrated during a qualification program of a 21 bits encoder carried out especially for optoelectronical and ASIC (Application Specific Integrated Circuits) components. Designs and manufactures for spatializable encoders with resolutions up to 22 bits in a 127 mm diameter are under development. Their angular accuracy can reach +/- 2 arc sec. These encoders, both absolute and incremental, function in a range of temperature going from approximately -40C to +100C. An integrated cold redundancy is available from a diameter of 36 mm as well as an integrated partial control of functions.
ESA
Coders; Optical Data Processing; Signal Encoding

19950020850 SSG, Inc., Waltham, MA, USA
Ultra-high, resolution, modular optical angle encoder for space-based opto-mechanical applications
Luther, Holger, SSG, Inc., USA; Beard, Paul, SSG, Inc., USA; Mitchell, Donald, BEI Sensors and Systems Co., USA; Thorburn, William, BEI Sensors and Systems Co., USA; NASA. Johnson Space Center, The 29th Aerospace Mechanisms Symposium; May 1, 1995, pp. p 136-146; In English; See also N95-27260 09-15; Avail: CASI; A01, Hardcopy; A04, Microfiche

A 27-bit optical encoder using a novel patent pending technology has been developed by the MicroE Development Center of BEI Sensors & Systems Company and tested by the Sensor Systems Group (SSG) Inc., in a positioning and stabilization mirror assembly (PSMA) designed and constructed under a grant from the Marshall Space Flight Center. Test results verified performance within the specifications of the PSMA.
Author
Coders; Design Analysis; Mechanical Devices; Optical Equipment

19950020868 Ball Corp., Aerospace Systems Div., Boulder, CO, USA
High-performance reactionless scan mechanism
Williams, Ellen I., Ball Corp., USA; Summers, Richard T., Ball Corp., USA; Ostaszewski, Miroslaw A., Ball Corp., USA; NASA. Johnson Space Center, The 29th Aerospace Mechanisms Symposium; May 1, 1995, pp. p 334-349; In English; See also N95-27260 09-15; Sponsored by Dick Maxwell; Avail: CASI; A03, Hardcopy; A04, Microfiche
A high-performance reactionless scan mirror mechanism was developed for space applications to provide thermal images of the Earth. The design incorporates a unique mechanical means of providing reactionless operation that also minimizes weight, mechanical resonance operation to minimize power, combined use of a single optical encoder to sense coarse and fine angular position, and a new kinematic mount of the mirror. A flex pivot hardware failure and current project status are discussed.
Author
Design Analysis; Electromechanical Devices; Infrared Spectrometers; Mirrors; Scanners; Technology Utilization

19950032710

Space-variant optical logic operations based on operation-dependent encoding method

Wong, K. W., Polytechnic of Hong Kong, USA; Cheng, L. M.; Applied Optics; April 10, 1994; ISSN 0003-6935; 33, 11, pp. 2134-2139; In English; Copyright; Avail: Issuing Activity

    Operation dependent encoding method is used to describe the performance of space variant logic operations in space invariant optical systems. Optical encoders have been designed to perform spaced variant input state encoding for all 16 Boolean functions, using liquid crystal cells and liquid crystal light valves. Application of the method to MIMD processing is indicated.

EI

Light Valves; Logic Circuits; Optical Data Processing; Signal Encoding

19960031275

Novel designs of programmable all-optical synchronous code-division multiple-access encoders and decoders

Zhang, Jian-Guo, Chinese Univ., Thailand; Kwong, Wing C.; Optical Engineering; July 1995; ISSN 0091-3286; 34, 7, pp. 2109-2114; In English; Copyright; Avail: Issuing Activity

    Novel-designs of programmable all-optical synchronous code-division multiple-access (CDMA) encoders and decoders are reported. They are based on cascades of optical delay lines and electro-optic switches. The operations of both optical encoders and decoders are illustrated with the well-known prime-sequence codes. Based on the proposed designs, these optical CDMA components can be constructed by integrated optics (i.e., the optical delay lines and switches are all fabricated on the same substrate). With the possibility of mass production and eliminating the fiber-waveguide interface power loss, better cost efficiency and lower power loss would be expected, as compared to the conventional designs.

Author (EI)

Code Division Multiple Access; Communication Equipment; Decoding; Integrated Optics; Optical Communication; Signal Encoding; Switches

19960053700

2(sup n) prime-sequence codes and coding architecture for optical code-division multiple-access

Kwong, Wing C., Hofstra Univ, USA; Yang, Guu-Chang; Zhang, Jian-Guo; IEEE Transactions on Communications; September 1996; ISSN 0090-6778; 44, 9, pp. 1152-1162; In English; Copyright; Avail: Issuing Activity

    Recent study shows that optical code-division multiple-access (CDMA) networks cannot be evaluated or designed by only considering the performance (i.e., correlation properties) of the optical pseudo-orthogonal codes selected. The structures of optical encoders and decoders are another important factors to consider and are needed to coordinate with the selected optical codes as much as possible. In this paper, a special family of 2(sup n) codes, so-called 2(sup n) prime-sequence codes, is constructed. A general theorem on the cardinality of the new codes is provided. The properties and performance of the codes are also studied. Since these codes pose the algebraic properties of both prime-sequence and 2(sup n) codes, new optical encoding and decoding structures are designed to optimize the system parameters (e.g., power budget and cost) of these optical CDMA networks. This new configuration is particularly attractive for ultrafast optical processing and waveguide implementation for the future high-capacity, low-loss, all-optical CDMA networks.

Author (EI)

Coding; Communication Networks; Fiber Optics; Multiplexing; Symbols

19980059433

DOE based wavelength multiplexing system for a single mode image transmission

Mendlovic, David, Tel Aviv Univ., Israel; Zalevsky, Zeev, Tel Aviv Univ., Israel; Marom, Emanuel, Tel Aviv Univ., Israel; Garcia, Javier, Valencia, Univ., Spain; Mas, David, Valencia, Univ., Spain; Ferreira, Carlos, Valencia, Univ., Spain; Lohmann, Adolf W., Erlangen-Nuernberg, Univ., Germany; 1997, pp. 442-450; In English; Copyright; Avail: Aeroplus Dispatch

The expanding usage of optical communication via optical fibers and the drastic increase of the data to be transmitted urge the exploration of novel systems allowing to transmit large amounts of spatial information by fiber with smaller spatial resolution. In this paper, an optical encoding and decoding system is suggested for transmitting 1D or 2D images via a single mode fiber. The superresolving system is based on the wavelength multiplexing of the input spatial information that is achieved with diffractive optical elements. Preliminary experimental results demonstrate the capabilities of the suggested method for the 1D case. Author (AIAA)

Wavelength Division Multiplexing; Image Processing; Optical Communication; Optical Fibers; Signal Transmission

19980071999

Tests of incremental rotary encoders

Robinson, Lloyd, Lick Observatory, USA; Kibrick, Robert, Lick Observatory, USA; Cowley, David, Lick Observatory, USA; Osborne, Jack, Lick Observatory, USA; 1997, pp. 42-49; In English; Copyright; Avail: Aeroplus Dispatch

We report on test results of rotary incremental encoders obtained with a test setup that compared the output of two such encoders driven by the same shaft. Although intrinsic nonlinear response of the encoders tested is specified to be less than +/- 15 arcsec, additional errors are often caused by the coupling of the encoder to a rotating device. Bearing runout and shaft misalignment typically require use of a flexible coupler, but tests with several types of small inexpensive flexible couplers have shown that these can contribute additional errors, including windup and nonuniform rotation that is affected by small changes in alignment. An additional minor source of error is due to a reproducible periodic error of several arcseconds generated in the interpolation electronics used to provide high resolution by subdividing the analog signal from the encoder. The driving torque required by a typical Gurley encoder is larger than might be expected, and has been measured at various speeds by determining the amount of windup with a solid aluminum coupling shaft. Author (AIAA)

Image Rotation; Performance Tests; Error Analysis; Signal Encoding

19990015823

New ultra-high sensitivity, absolute, linear, and rotary encoders

Leviton, Douglas B., NASA Goddard Space Flight Center, USA; 1998, pp. 100-111; In English; Copyright; Avail: Aeroplus Dispatch

Several new types of absolute optical encoders of both rotary and linear functions are discussed. The means for encoding are complete departures from conventional optical encoders and offer advantages of reliability, compact form, immunity to damage-induced dropouts of position information, and about an order of magnitude higher sensitivity over what is commercially available. Rotary versions have sensitivity from 0.02 arcsec down to 0.003 arcsec, while linear models have demonstrated sensitivity of 10 nm with higher sensitivities possible. Author (AIAA)

Optical Equipment; Signal Encoding; Photosensitivity

19990016525
Compact optical encoder approach utilizing novel diffractive optics design

DeVoe, Catherine E., MicroE, Inc., USA; Horwitz, Bruce A., MicroE, Inc., USA; Johnson, Eric G., Digital Optics Co., USA; Fedor, Adam S., Digital Optics Co., USA; 1998, pp. 186-192; In English

We describe a monolithic source/optics/detector encoder module we have designed and prototyped for a satellite application under a NASA Phase I SBIR contract. The next generation of integrated microoptical encoders is discussed.
Author (AIAA)

Optical Data Processing; Diffractive Optics; Integrated Circuits; Coders

19990092644
Optical encoder using metallic surface grating

Hane, Kazuhiro; Okuyama, Kenichi; Sasaki, Minoru; Seimitsu Kogaku Kaishi/Journal of the Japan Society for Precision Engineering; Oct, 1998; ISSN 0912-0289; Volume 64, no. 10, pp. 1532-1536; In Japanese; Copyright; Avail: Issuing Activity

With an intense thermal variation, optical encoder yields measuring error because of the generation of nonlinear strain due to the difference of the thermal expansion coefficient between a glass scale and a metallic parts of machines. In this study, a method of using a grating which is directly manufactured on a metallic surface of parts of machines is proposed. Using this method, the thermal strain is made linear and the error becomes simplified to calibrate. Furthermore, it realizes a miniaturization of the system and improves its vibration-resistance. This paper shows the process of making a grating on a metallic surface by photolithography using some methods and ascertains the sufficient performance of this scale in an optical encoder.
Author (EI)

Coding; Image Processing; Gratings (Spectra); Photolithography; Optical Measurement; Errors

19990094291 NASA Goddard Space Flight Center, Greenbelt, MD USA
New Ultra-High Sensitivity, Absolute, Linear, and Rotary Encoders

Leviton, Douglas B., NASA Goddard Space Flight Center, USA; 1998; In English; Cryogenic Optical Systems and Instruments, 19-24 Jul. 1998, San Diego, CA, USA; Sponsored by International Society for Optical Engineering; Copyright; Avail: Issuing Activity, Hardcopy; Abstract Only

Several new types of absolute optical encoders of both rotary and linear function are discussed. The means for encoding are complete departures from conventional optical encoders and offer advantages of compact form, immunity to damage-induced dropouts of position information, and about an order of magnitude higher sensitivity over what is commercially available. Rotary versions have sensitivity from 0.02 arcseconds down to 0.003 arcsecond while linear models have sensitivity of 10 nm.
Author

Sensitivity; Coders; Linear Systems; Optical Equipment

19990109505

Optical encoder using a slit-width-modulated grating

Ieki, A., Okuma Corp., Japan; Hane, K.; Yoshizawa, T.; Matsui, K.; Nashiki, M.; Journal of Modern Optics; Jan 15, 1999; ISSN 0950-0340; Volume 46, no. 1, pp. 1-14; In English; Copyright; Avail: Issuing Activity

In this paper we propose a simple optical encoder using slit-width-modulated gratings. The distortion of the encoder signal (harmonic noise) is reduced by using the slit-width-modulated gratings to obtain a sinusoidal curve. The intensity of the light transmitted through the super-imposed gratings was investigated by the Fresnel diffraction theory. The Fourier coefficient of the gratings was analyzed in order to reduce the distortion of the encoder signal. For practical use, the slit width of the gratings was designed to reduce the third and fifth harmonics of the encoder signal. In the experiment, the slit-width-modulated gratings were fabricated by optical lithography. It was confirmed that the signal distortion was reduced and virtually independent of the air gap between the two gratings. Since the interpolation error is considerably suppressed, the proposed technique will be useful in precision machining.

Author (EI)

Coding; **Image Processing**; **Gratings (Spectra)**; **Light Transmission**; **Signal Distortion**; **Harmonic Analysis**

19990114831

The implementation of an incremental optical encoder for submicroradian measurement of gimbal pointing angles

Galetti, Ralph R., SVS Systems, Inc., USA; Baugh, Steve, SVS Systems, Inc., USA; Gonzales, Damien M., SVS Systems, Inc., USA; Herman, Edward J., SVS Systems, Inc., USA; Nixon, Matt D., SVS Systems, Inc., USA; 1999, pp. 274-287; In English; Copyright; Avail: AIAA Dispatch

The implementation of an incremental optical encoder for measurement of gimbal pointing angles is discussed. The application described is typical of many programs being conducted at SVS Systems, Inc. Performance requirements, such as resolution, accuracy, bandwidth, size, and weight, are described, and the advantages of using the optical encoder instead of more traditional technologies are given. The resolution of the optical encoders is on the order of 20 nanoradians. Disadvantages to using the optical incremental encoders are discussed as implementation challenges. An overview of how these challenges were overcome is described. A control system implementation using the encoders for gimbal stabilization is presented, including simulation results. The combination of resolution, repeatability, and accuracy of the encoders opens new possibilities for gimbal stabilization without rate sensors attached to the pointing mirror, as shown through simulation. Test results verifying the proper operation of the encoder are presented.

Author (AIAA)

Gimbals; **Signal Encoding**; **Optical Measuring Instruments**; **Systems Stability**; **Optical Control**; **Image Resolution**

Astronomy

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

19960008765 Zeiss (Carl), Oberkochen, Germany
The Zeiss 2.5 m telescope for observation of graviational lens systems Zeiss – 2.5 m – Teleskop zur Beobachtung von Gravitationslinsen-Systemen

Schulte, Joachim, Zeiss (Carl), Germany; Megaphot e.V., The Need for a Dedicated Optical Quasar Monitoring Telescope; Jan 1, 1993, pp. p 155–159; In German; See also N96-15916 03-89; Copyright; Avail: Issuing Activity (MEGAPHOT e.V., Hamburg, Germany), Unavail. Hardcopy, Unavail. Microfiche; Original contains color illustrations

A telescope on an azimutal mounting for the automatic monitoring of gravitational lens systems is presented. The telescope was designed for high reliability and maintainability, with long maintenance cycles based on the built-in test principle. The long wave aberrations can be online measured with a wavefront sensor and can be compensated with control actuators. A Nasmyth focus is available, equipped with a derotator and an optical bench, on which charge coupled device cameras and active optical systems are implemented, as well as an articulate mirror, which supplies the light to the input of a light guide and then to a spectrograph. As propulsion system, a multiple motor system was chosen, which is controlled with high dynamics using incremental and absolute encoders and tachogenerators.
Author (ESA)

Aberration; **Azimuth**; **Gravitational Lenses**; **Telescopes**